TI Sitara™ ARM Microprocessors

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Application Engineer

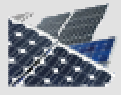
Texas Instruments

TI Embedded Processors Portfolio

TI Embedded Processors

Microcontrollers (MCUs)			ARM®-Based Processors	Digital Signal Processors (DSPs)	
16-bit ultra-low power MCUs	32-bit real-time MCUs	32-bit ARM Cortex™-M3 MCUs	ARM Cortex-A8 MPUs	High-performance DSPs	Low-power DSPs
MSP430™	**C2000™ Delfino™ Piccolo™**	**Stellaris®** ARM® Cortex™-M3	**Sitara™** ARM® Cortex™-A8 & ARM9	**C6000™ DaVinci™ OMAP™**	**C5000™**
Up to 25 MHz	40MHz to 300 MHz	Up to 100 MHz	300MHz to >1GHz	300MHz to >1GHz +Accelerator	Up to 300 MHz +Accelerator
Flash 1 KB to 256 KB	Flash, RAM 16 KB to 512 KB	Flash 64 KB to 256 KB	Cache, RAM, ROM	Cache RAM, ROM	Up to 320KB RAM Up to 128KB ROM
Analog I/O, ADC LCD, USB, RF	PWM, ADC, CAN, SPI, I²C	USB, ENET MAC+PHY CAN, ADC, PWM, SPI	USB, CAN, PCIe, EMAC	USB, ENET, PCIe, SATA, SPI	USB, ADC McBSP, SPI, I²C
Measurement, Sensing, General Purpose	Motor Control, Digital Power, Lighting, Ren. Energy	Connectivity, Security, Motion Control, HMI, Industrial Automation	Industrial computing, POS & portable data terminals	Test & Meas., Video, audio, security, imaging, infrastructure	Port. Telecom, audio, medical monitor & diag, industrial
$0.49 to $9.00	$1.50 to $20.00	$1.00 to $8.00	$5.00 to $20.00	$5.00 to $200.00	$3.00 to $10.00







Software & Dev. Tools


MPUs – Microprocessors

What is Sitara™?

What's new

- New platform of high-performance ARM microprocessors:
  - ARM9 to ARM® Cortex™-A8 MPU's
- First new devices:
  - AM35xx & AM17xx/AM18xx
- Coming soon:
  - , AM3703/AM3715
- Software compatible roadmap

Ideal for applications requiring

- High-level operating system
- 300MHz – 1GHz+ in future devices
- Advanced graphical user interfaces
- Flexible connectivity and multiple interface options
- High system integration
- And…
  - Scalability
  - System cost constraints
  - Application software portability

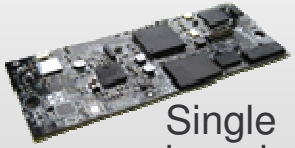
Sitara ARM MPUs – a good fit for industrial, instrumentation, POS

HVAC and building controls

Industrial automation

Test & measurement

Medical instrumentation



Single board computing

Point of service

Sitara™ ARM® microprocessors

Available Now

ARM9

AM1705
AM1707
AM1806
AM1808

Low power ARM9 with Integrated peripherals

- Power efficient (down to 7mW standby, 182mW active)
- Cost efficient
- Flexible industrial I/O PRU (CAN, UART)
- Integrated peripherals, 10/100 Ethernet, USB, SATA, and many more

ARM Cortex-A8

OMAP3503
OMAP3515
AM3505
AM3517

Advanced ARM Cortex-A8 with system integration

- Up to 1440 DMIPS
- Integrated interfaces to display, USB, 10/100 Ethernet, SD card, Wi-Fi®, CAN, and many others
- Integrated graphics for rich user interface functions

In Development

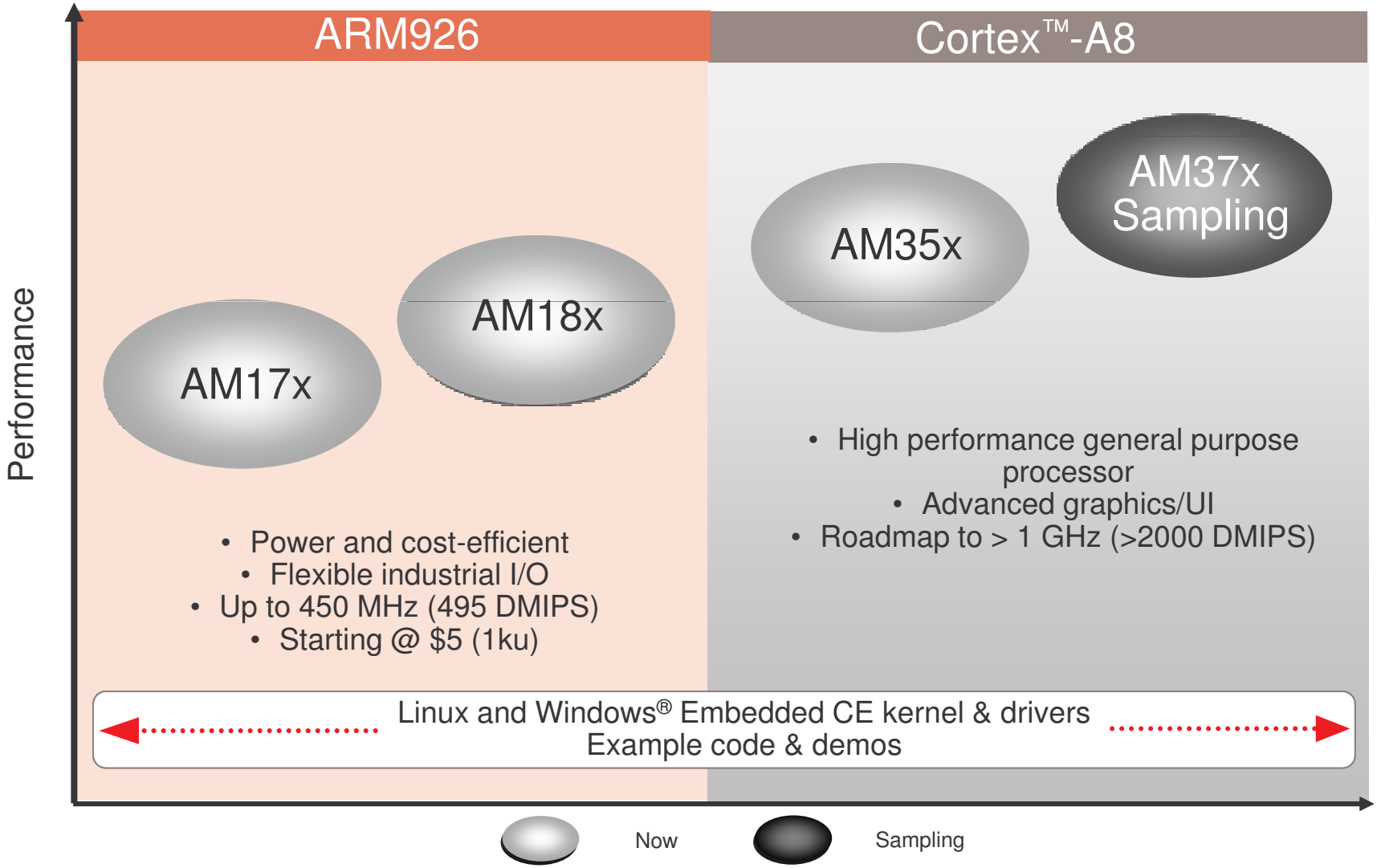
ARM Cortex-A8

AM37xx (2Q10)
"AM38x Next" (2011)
"AM33x Next" (2011)

Higher Performance Cortex-A8 with enhanced integration

- Up to 2000 DMIPS
- Power efficient (down to 10mW standby, 1W active)
- Enhanced graphics/UI
- Enhanced integrated peripherals, 1Gb Ethernet, PCIe

Develop product designs with TI's expanding Sitara™ MPU portfolio



CORTEX-A8

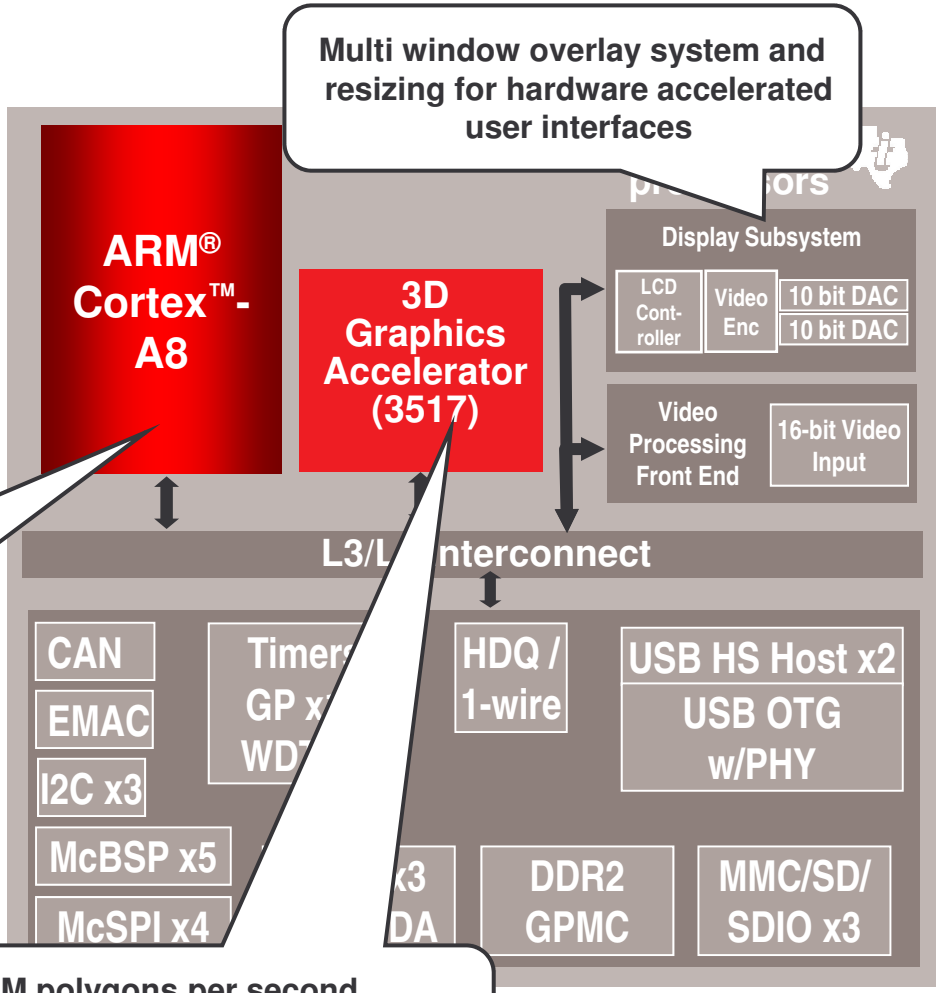
PRODUCT DETAILS

AM3517/05 Core and Accelerators

Features

- **Cores**
  - 600 MHz Cortex A-8 with NEON™ coprocessor
  - PowerVR SGX 3D graphics Accelerator – up to 10M polygons / second
- **Memory**
  - ARM:
    - 16 kB I-Cache; 16 kB D-Cache; 256kB L2 Cache
  - On chip: 64kB SRAM; 128kB ROM
  - DDR2 interface
  - GPMC: NAND/NOR I/F

Up to 1000 Dhrystone MIPS:
- OS's like Linux or WinCE
- Excellent web experience

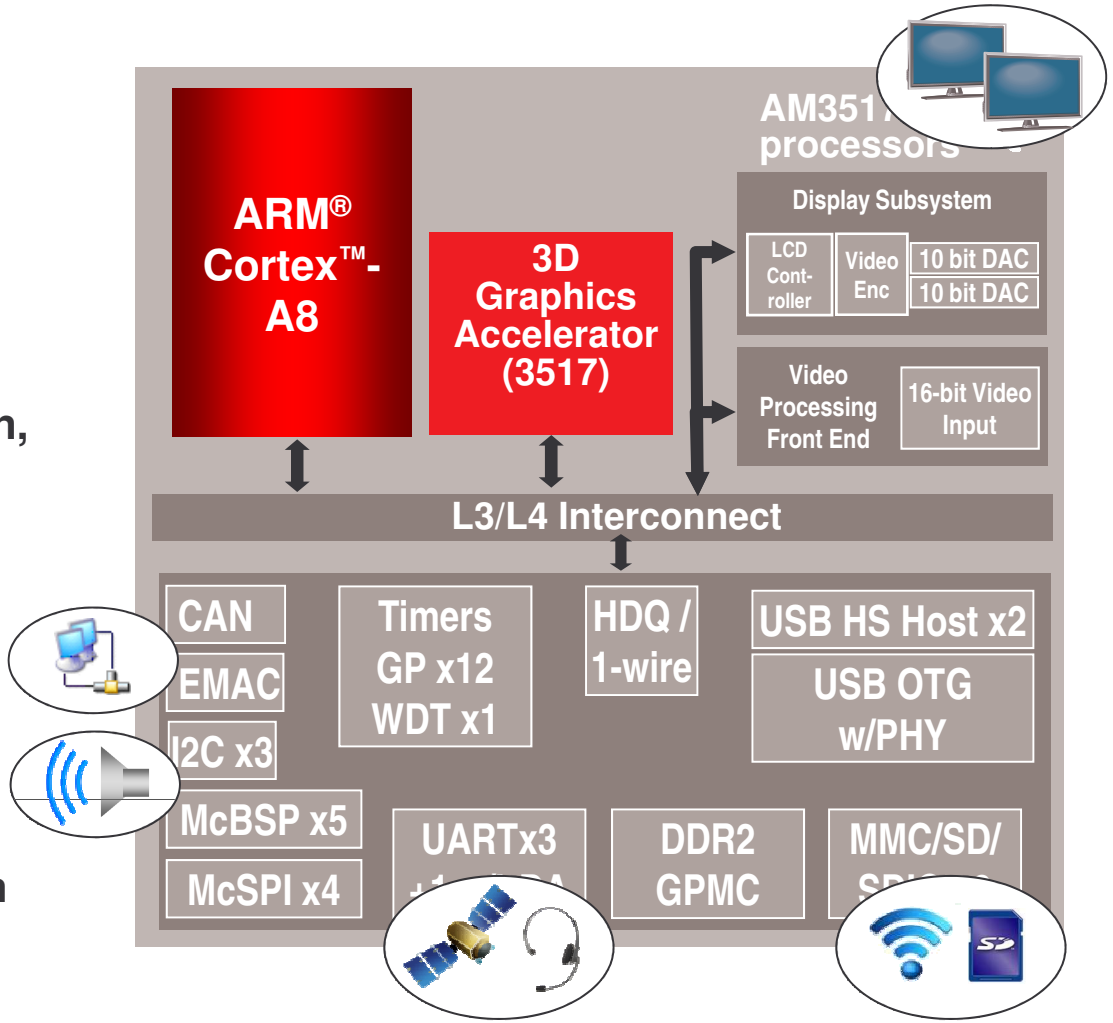


- Up to 10M polygons per second
- Hardware based on screen display
- Easily create robust GUI's

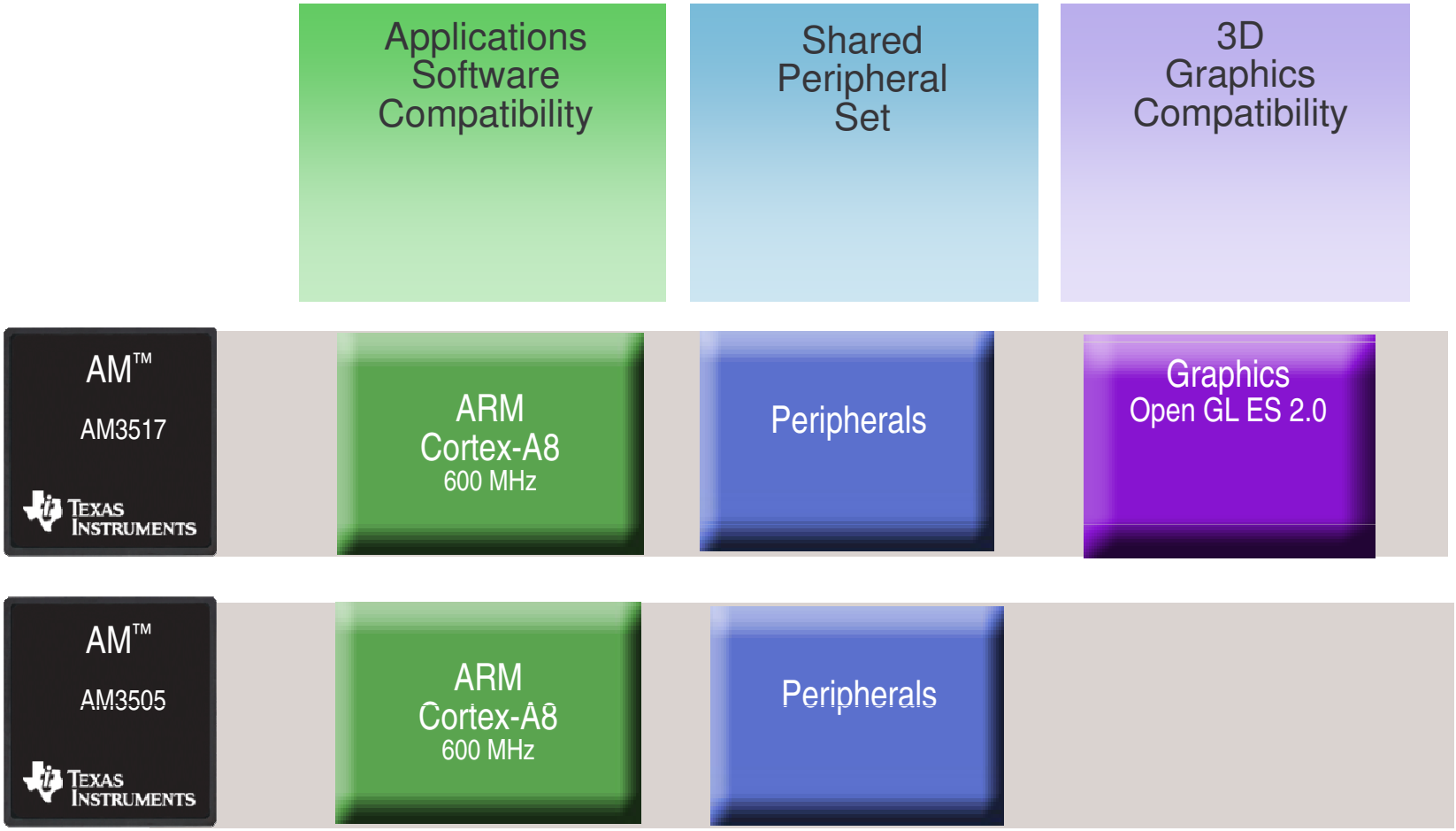
AM3517/05 Peripherals

Features

- **Peripherals**
  - CAN – High end controller area network Controller (HECC)
  - USB 2.0 OTG w/PHY
  - RMII EMAC controller 10/100
  - USB HS host x2
  - MMC/SD card interface x3
  - LCD controller and TV out
  - Display subsystem with PIP, color space conversion, rotation, resizing
  - 1.8V or 3.3V IO
- **Power**
  - Total Power: 0.5W – 1.5W
  - Standby Power: 12mW
- **Package**
  - ZCN – 17x17 mm, 0.65 mm pitch Utilizes Via Channel™ Array Technology with 0.8mm pitch plus design rules.
  - ZER – 23x23 mm, 1.0mm pitch.



AM3505/17 Platforms



Pin-for-pin compatible

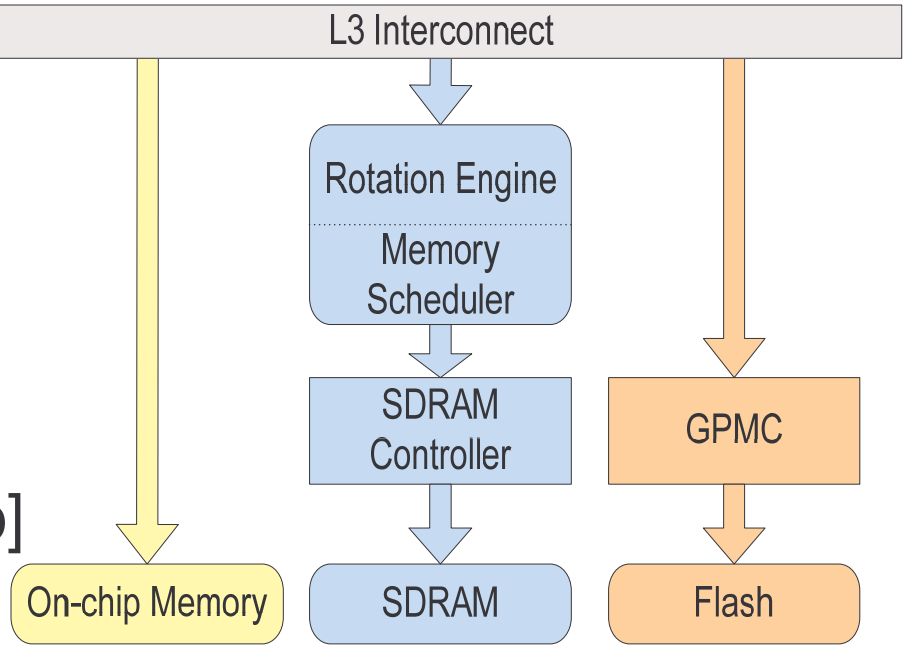
Availability subject to applicable lead times

CORTEX A-8 : Highlights

- First ARMv7 instruction-set architecture
- Superscalar architecture delivers high performance
  - Advanced dynamic Branch prediction
- 256 KB unified L2 cache
  - Dedicated, low-latency, high-BW interface to L1 cache
- Enhanced VFPv3
  - Doubles number of double-precision registers
  - Adds new instructions to convert between fixed and floating point
- Efficient Run Time Compilation Target
  - Jazelle-RCT: Target for Java. Memory footprint reduced up to 3x
- Trust Zone
  - Normal & Secure worlds have different memory views

AM35x Memory Controller

- Two dedicated memory controllers/one internal memory
  - SDRAM controller (EMIF4)
  - General purpose memory controller (GPMC)
  - Internal memory (SRAM)
- On Chip Memory [SRAM-64 Kb]
- Operates at full L3 interconnect (64bit@Core Clock /2)



GPMC Controller

- 16-bit external memory controller
- GPMC can communicate with many external devices:
  - External asynchronous/synchronous 8-bit wide memory/device
  - External asynchronous/synchronous 16-bit wide memory/device
  - External 16-bit non-multiplexed device with limited address range (2 Kbytes)
  - External 16-bit address/data-multiplexed NOR flash device
  - External 8-bit/16-bit NAND flash device
  - External 16-bit pseudo SRAM (pSRAM) device

	AM35x
Supported	PsRAM, OneNAND, NOR/NAND Flash, ASYNC Logic
Supported Size (bits)	1GB (128MB per CS-mux mode) 16 KB (2 KB per CS non-mux mode)
Max Clock Speed	100 MHz
Chip Selects	8
Max Address Space	2 KB non mux mode 128 MB mux mode
Data Width	16 b

DDR Controller

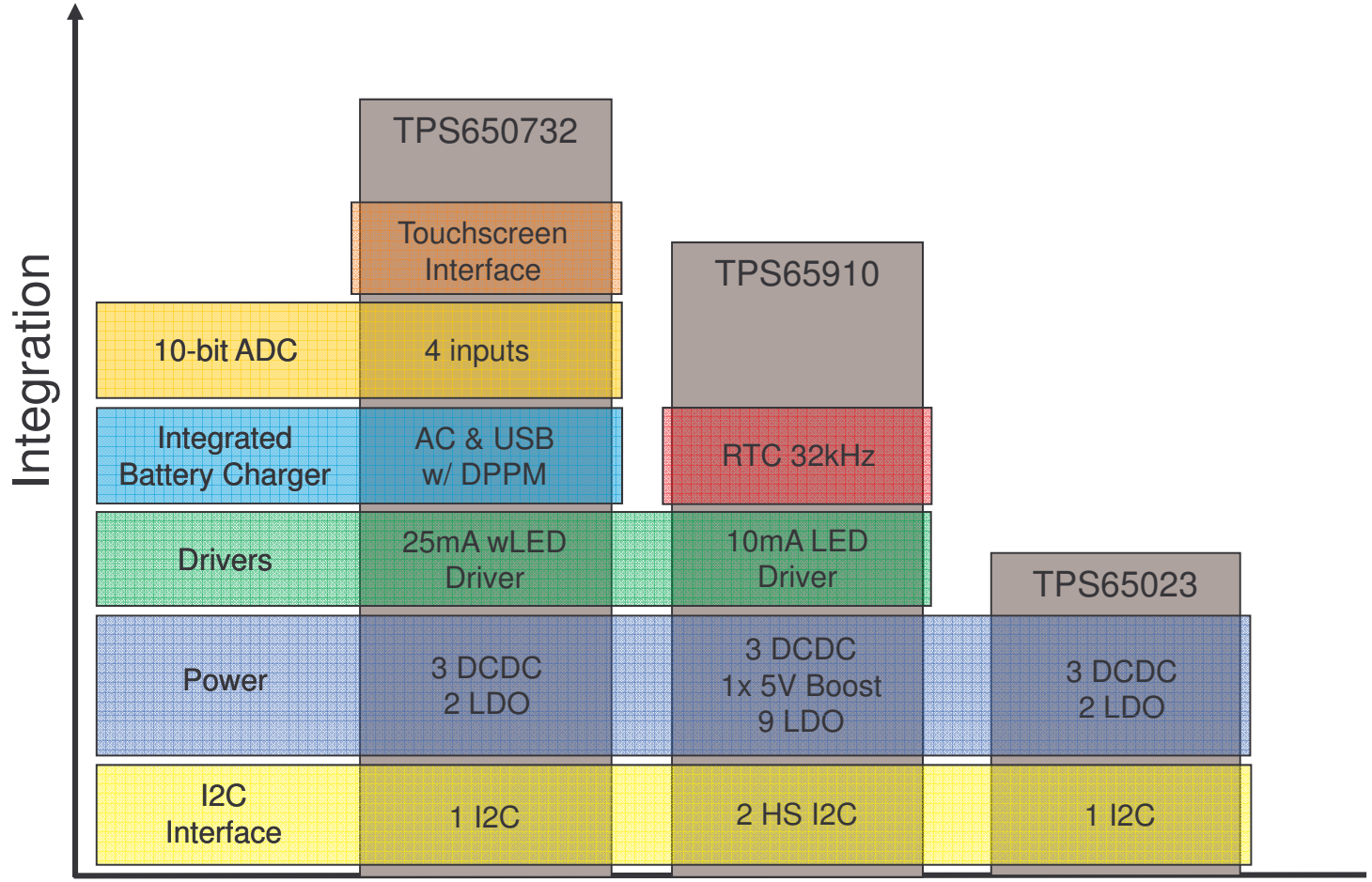
- Supports mDDR / DDR2
- DDR controller has three functional blocks:
  - Virtual Rotated Frame Buffer (VRFB), supporting rotations of 0°, 90°, 180°,270°
  - SDRAM memory-access scheduler (SMS)
    - Optimizes latency and bandwidth usage among requestors
  - SDRAM Controller
    - Physical interface to DDR2 or mDDR
    - Two chip selects

	AM3517/05
SDRAM Supported	mDDR/DDR2
Measured Throughput	810MB/sec
Supported Size (bits)	16M, 32M (2 Banks) 64M, 128M, 256M, 512M,1G, 2G (4 Banks)
Max Clock Speed	166MHz
Chip Selects	2
Data Width	16/32b

Power Management

- AM35x power management features:
  - Single voltage and power domain
  - Multiple clock domains
  - Single Operating Voltage and Frequency
  - Low power mode (standby)
- Power, Reset and Clock Management (PRCM) module controls power management
- One voltage supply to device processors and peripherals.
- Supports dynamic clock gating for power management through clock domains.
  - A clock domain is a group of modules or subsections of device that share a common clock
  - By gating the clock to each domain, it is possible to cut a clock to a group of inactive modules to lower their active power consumption.

AM35x Power Options



AM35x development tools

AM3517 evaluation module

$995

- AM3517
- PowerVR SGX
- Integrated processor, power and Wifi module
- Touch screen LCD
- CAN, JTAG, Ethernet and more via applications board
- Modular design
- Linux and Windows® Embedded CE

AM3517 eXperimenter

$199

- Includes Module and interface board found on AM3517EVM
- Touch screen LCD available for purchase separately
- Available only through LogicPD

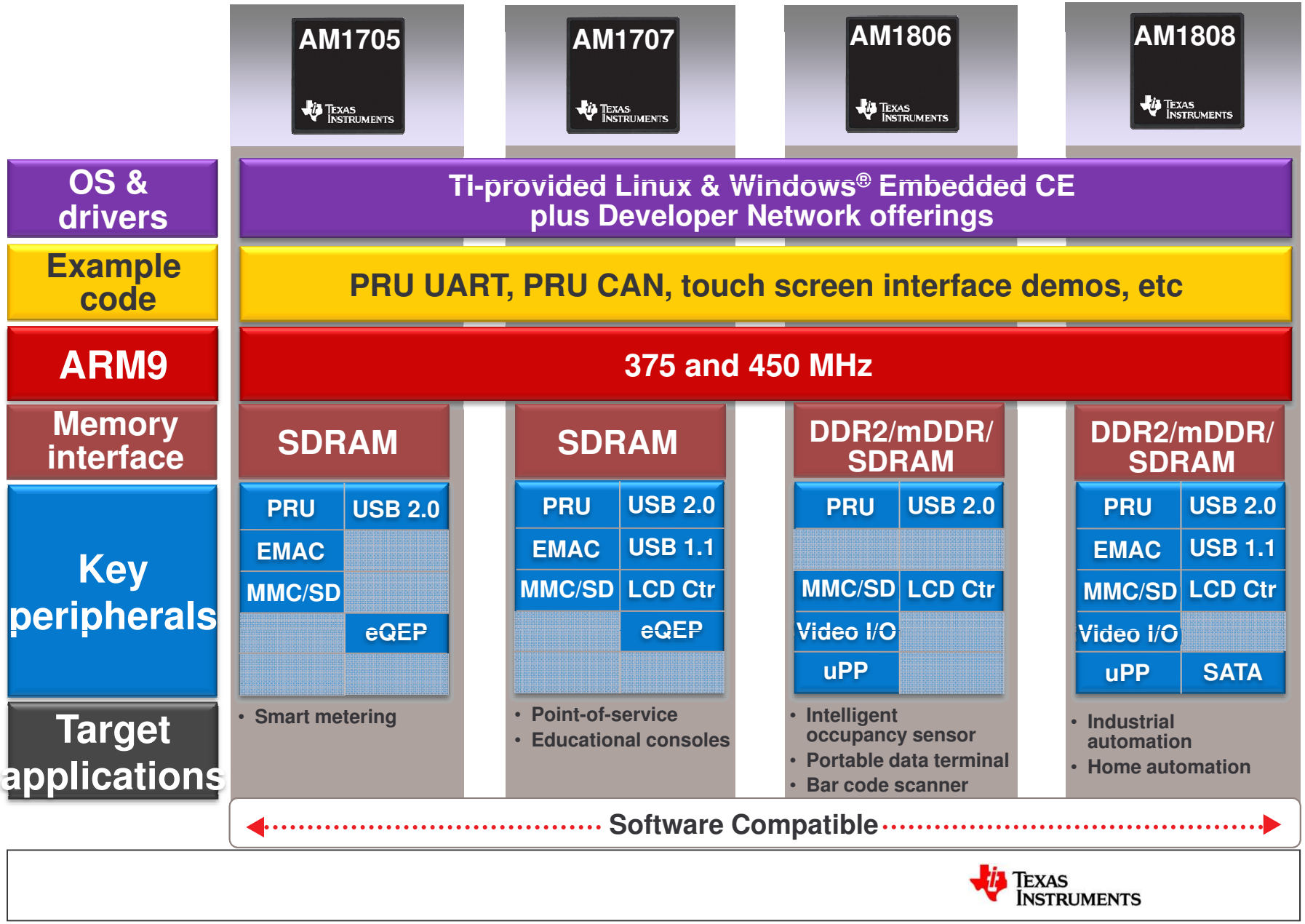
Getting Help

- TI E2E forums
  - http://e2e.ti.com
- Embedded Processor Wiki page:
  - http://wiki.omap.com/index.php/Main_Page
- Self Serve Collateral
  - http://ap-fpdsp-swapps.dal.design.ti.com/index.php/Self_serve_collateral
- OMAP Developer Series Videos (5 Parts)
  - http://focus.ti.com/docs/prod/folders/print/omap3530.html (or on YouTube)
- Online Training→ www.ti.com/onlinetraining

ARM-9

PRODUCT DETAILS

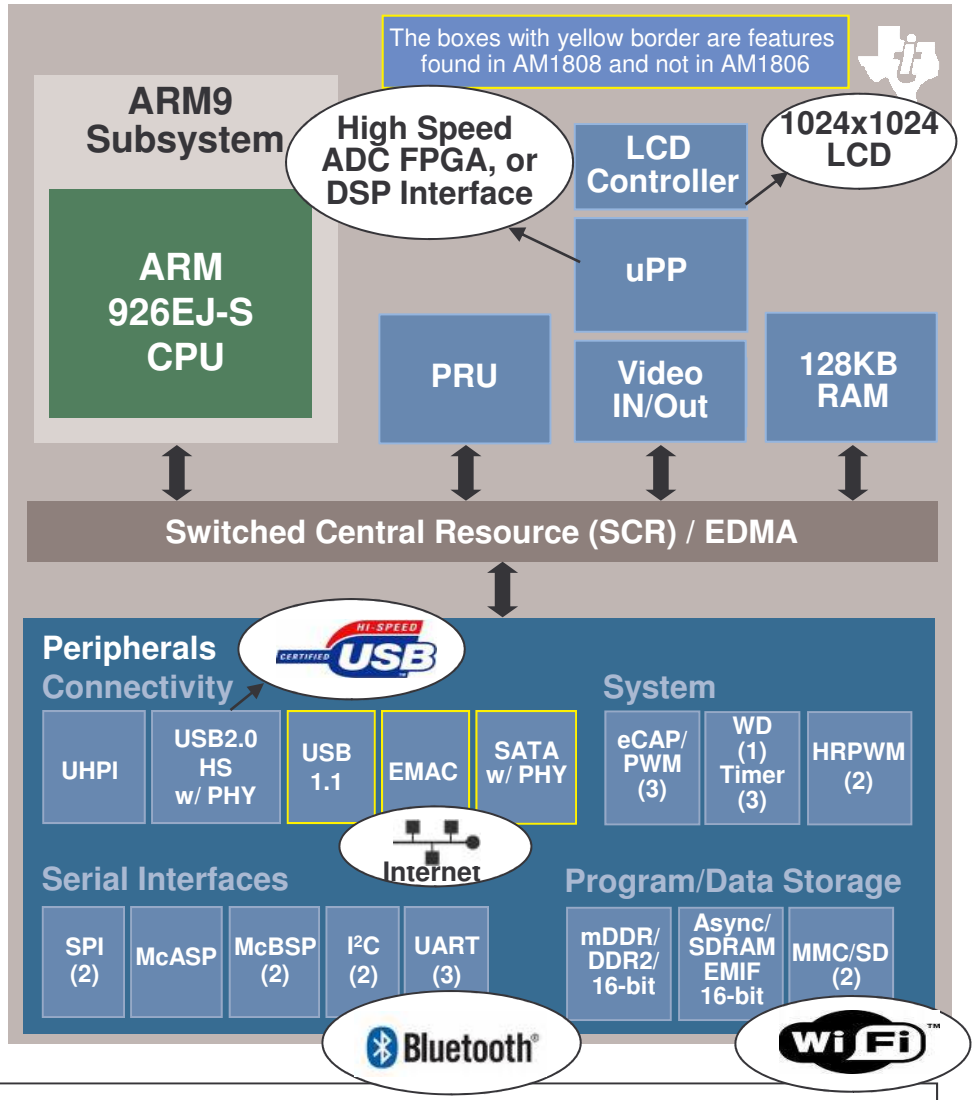
Multiple peripheral, memory and performance combinations



AM1808/1806 microprocessors

Features

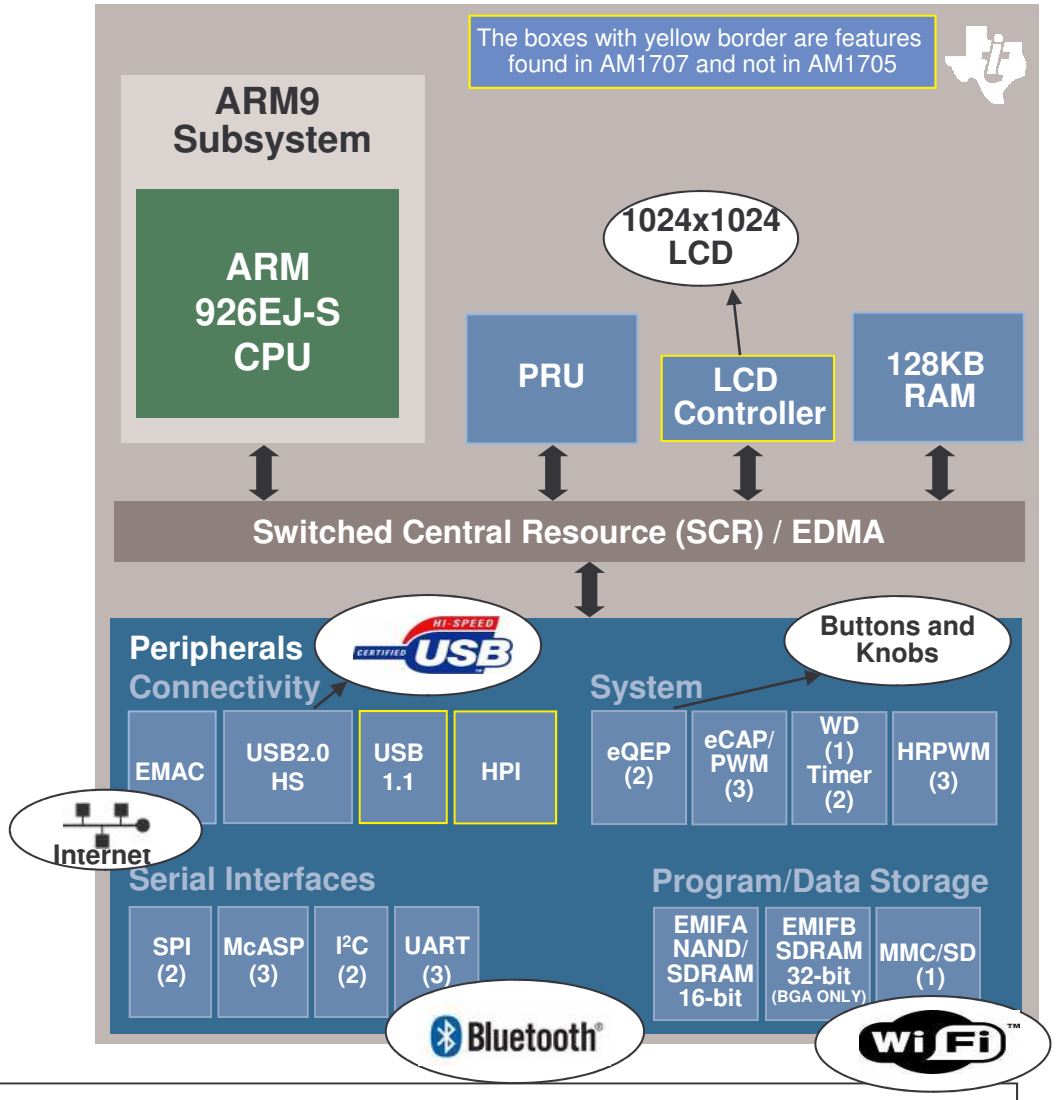
- **CPU Cores**
  - ARM926EJ-S™ (MPU) up to 450 MHz
- **Memory**
  - ARM:
    - 16KB – L1 Program Cache
    - 16KB – L1 Data Cache
  - On-chip 128KB RAM
  - mDDR, DDR2, SDRAM
- **Peripherals (1.8/ 3.3V IOs)**
  - 10/100 Ethernet MAC
  - EMIFA - DDR (mDDR/DDR2)
  - EMIFB – SDRAM/NAND Flash
  - Video Port I/F – Video In/Out (BT.656)
  - uPP and USB 2.0 OTG
  - SATA and USB 1.1 H/D (AM1808 only)
- **Power (1.0-1.2V Core, 1.8/3.3V IOs)**
  - Total Power < 182mW @ 300MHz, 1.2V, 25C
  - Standby Power < 7mW @ 1.2V/ 25C
- **Package**
  - 13 x13mm nFBGA (0.65mm), 16x16mm BGA (0.8mm)
  - Extended Temperature Grade Options
    - Commercial (0C to 90C)
    - Industrial (-40 to 90C)
    - Extended (-40C to 105C)
  - Pin to pin compatible processors:
    - AM1808/AM1806/OMAP-L138



AM1707/1705 microprocessors

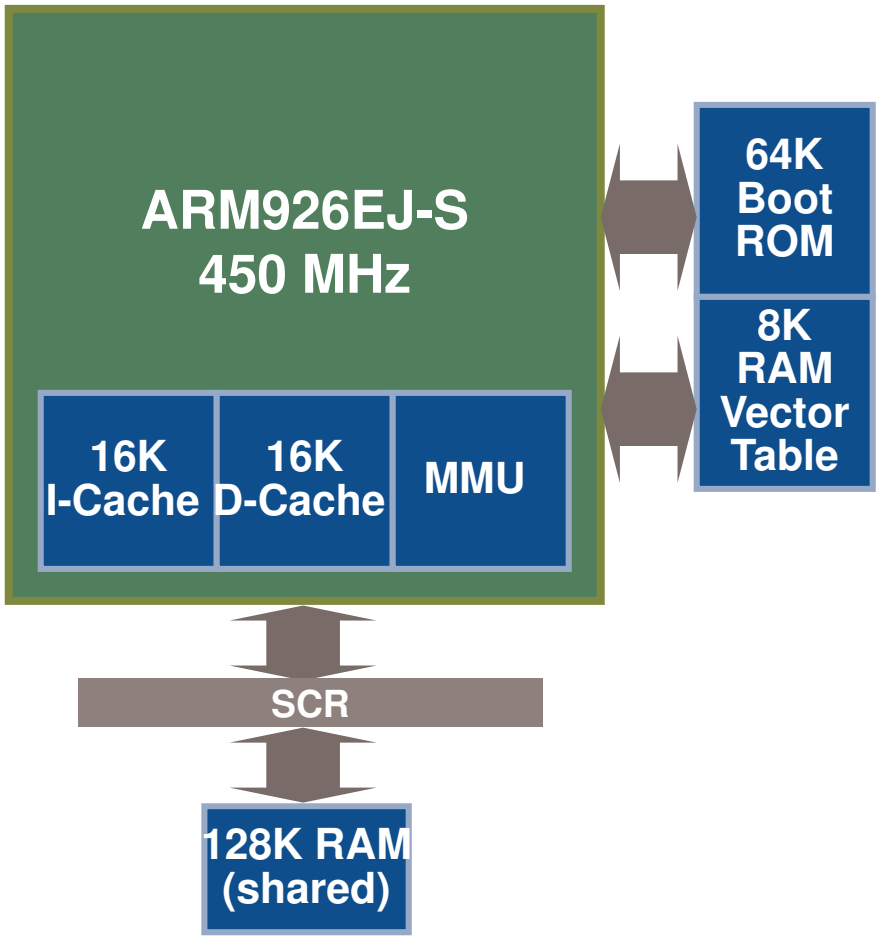
Features

- **CPU Cores**
  - ARM926EJ-S™ (MPU) up to 450 MHz
- **Memory**
  - ARM:
    - 16KB – L1 Program Cache
    - 16KB – L1 Data Cache
  - On-chip 128KB RAM
  - SDRAM
- **Peripherals (1.8/ 3.3V IOs)**
  - 10/100 Ethernet MAC
  - EMIFA – Supports Async/NAND Flash (8/16-bit)
  - EMIFB – Supports 133 MHz SDRAM (16/32-bit)
  - USB 2.0 OTG
  - USB 1.1 H/D (AM1707 only)
- **Power (1.0-1.2V Core, 1.8/3.3V IOs)**
  - Total Power < 270mW @ 300MHz, 1.2V, 70C
  - Standby Power < 62mW @ 1.2V/ 25C
- **Package**
  - 17x17mm BGA (1.0mm) (AM1707 only)
  - 26x26mm QFP (1.0mm), 176 Pins (AM1705 only)
  - Extended Temperature Grade Options
    - Commercial (0C to 90C)
    - Industrial (-40 to 90C)
    - Extended (-40C to 105C)
    - Automotive (-40C to 125C) (AM1707 only)
  - Pin to pin compatible processors:
    - AM1707/AM1705/OMAP-L137



CPU Core – ARM926EJ-S

- 375/450 MHz ARM926EJ-S
  - Includes MMU
- 16K I-Cache
- 16K D-Cache
- 64K ROM
  - Boot ROM
- 8K RAM (Vector Table)
- ARM Interrupt Controller
  - 32-inputs
  - Configurable Priority



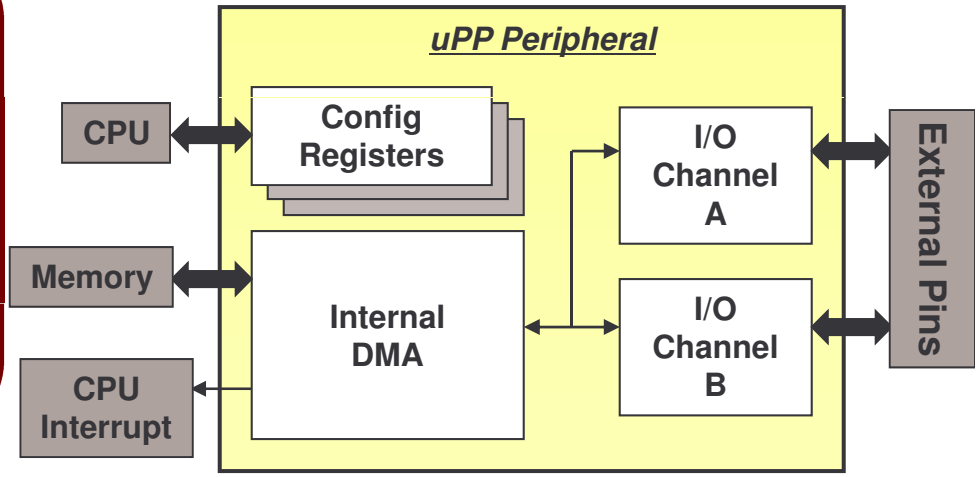
Universal Parallel Port (uPP AM18x only)

What Is uPP?

- High Speed parallel data port
- Two Bidirectional and Independent 16bit channels
- Internal dedicated DMA to streamline data I/O
- Simple I/O Protocol

Value of uPP

- Efficient Processor to FPGA communication enabled by high speed data I/O
- Enable multi-processor system design in various topologies
- Interface with high speed ADCs and DACs



Configuration	Throughput (MB/s)
1 Ch, 16-bit	120
2 Ch, 1 Way, 8-bit	120
2 Ch, 1 Way, 16-bit	160
2 Ch, 2 Way, 16-bit	240
HPI (16-bit)	50

Programmable Real-time Unit (PRU)

1. **What is PRU?**
   - **P**rogrammable **R**eal-time **U**nit Subsystem
   - Dual 32bit RISC processors running at ½ CPU freq.
   - Local instruction and data RAM. Access to chip-level resources

2. **Why PRU?**
   - Full programmability allows adding customer differentiation
   - Efficient in performing embedded tasks that require manipulation of packed memory mapped data structures
   - Efficient in handling of system events that have tight real-time constraints.

PRU Value

1. Extend Connectivity and Peripheral capability

- Implement special peripherals and bus interfaces (e.g. UARTs)
- Implement smart data movement schemes. Especially useful for Audio algorithms (e.g. Reverb, Room Correction)

2. Reduce System Power Consumption

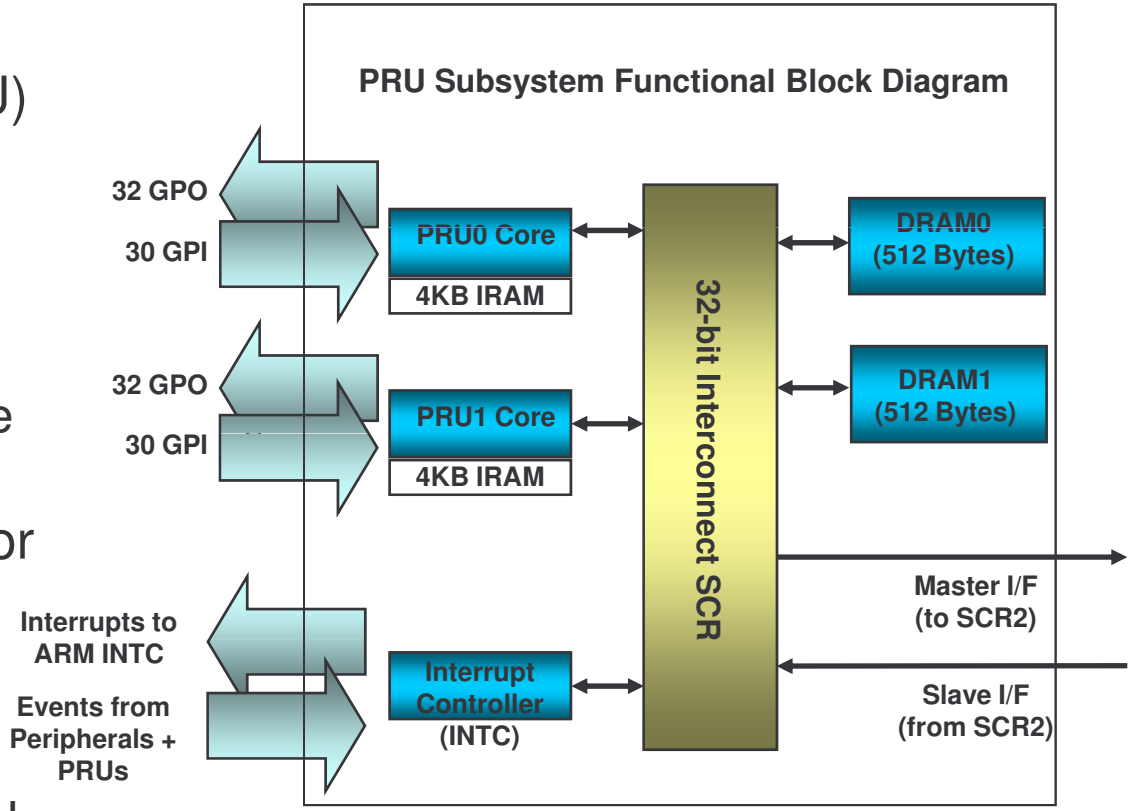
- Allows switching off the ARM clocks
- Implement smart power controller by evaluating events before waking up ARM. Maximized power-down time.

3. Accelerate System Performance

- Full programmability allows custom interface implementation
- Specialized custom data handling to offload ARM for innovative signal processing algorithm implementation

PRU Subsystem

- Provides two independent programmable real-time (PRU) cores
  - 32-Bit Load/Store RISC architecture
  - 4K Byte instruction RAM (1K instructions) per core
  - 512 Bytes data RAM per core
- PRU operation is little endian
- Includes Interrupt Controller for system event handling
- I/O interface
  - 30 input pins and 32 output pins per PRU core (AM18x)
  - AM17x does not support PRU I/O
- Power management via single power/sleep controller (PSC)



http://processors.wiki.ti.com/index.php/Programmable_Realtime_Unit_Subsystem

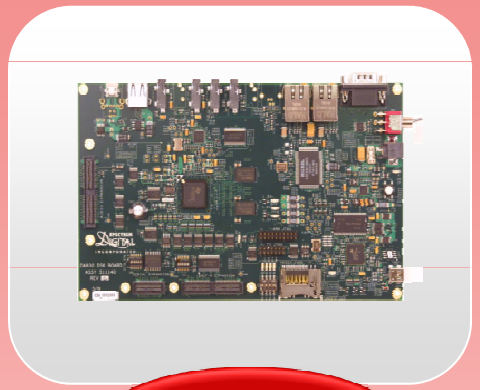
AM1x development tools

AM18x evaluation module

$1150

- Supports AM18x, C674x, or OMAP-L138 SOMs
- Touch screen LCD
- Full peripheral access
- Connector for PRU daughter card
- Experimenter kit available for $445

AM17x evaluation module



$845

- Touch screen LCD
- Full peripheral access
- Connector for PRU daughter card

Hawkboard

$89

- Community board for OMAP-L138

hawkboard.org

Order entry open now!

Sitara

Software

It's all about the software!

Sitara™ AM35x MPUs

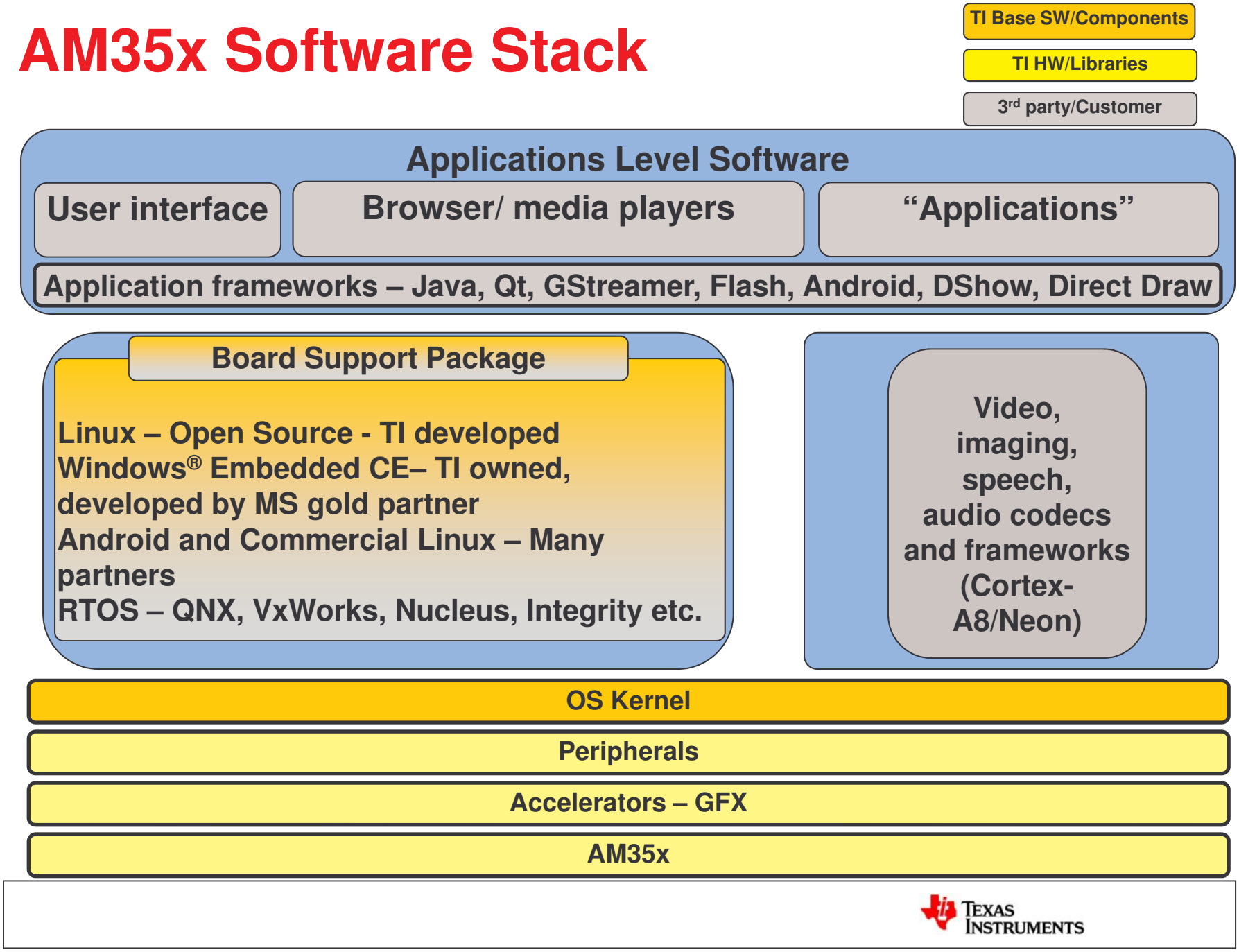
Innovative software – NRE and royalty-free

- **Full software development kit including:**
  - Base port to multiple industry leading Operating Systems
    - Linux kernel 2.6.32 BSP
    - Windows® Embedded CE 6.0 BSP
  - Full peripheral driver library
  - Graphics demos
  - Flashing, pad configuration, and PinMux utilities
- **These are just a few of the many features TI provides to start your application development**

Active open source community and large ecosystem of developers:

RealView Tools by ARM® | CodeSourcery | Microsoft Windows CE | Linux Powered | Android

AM35x Software Stack



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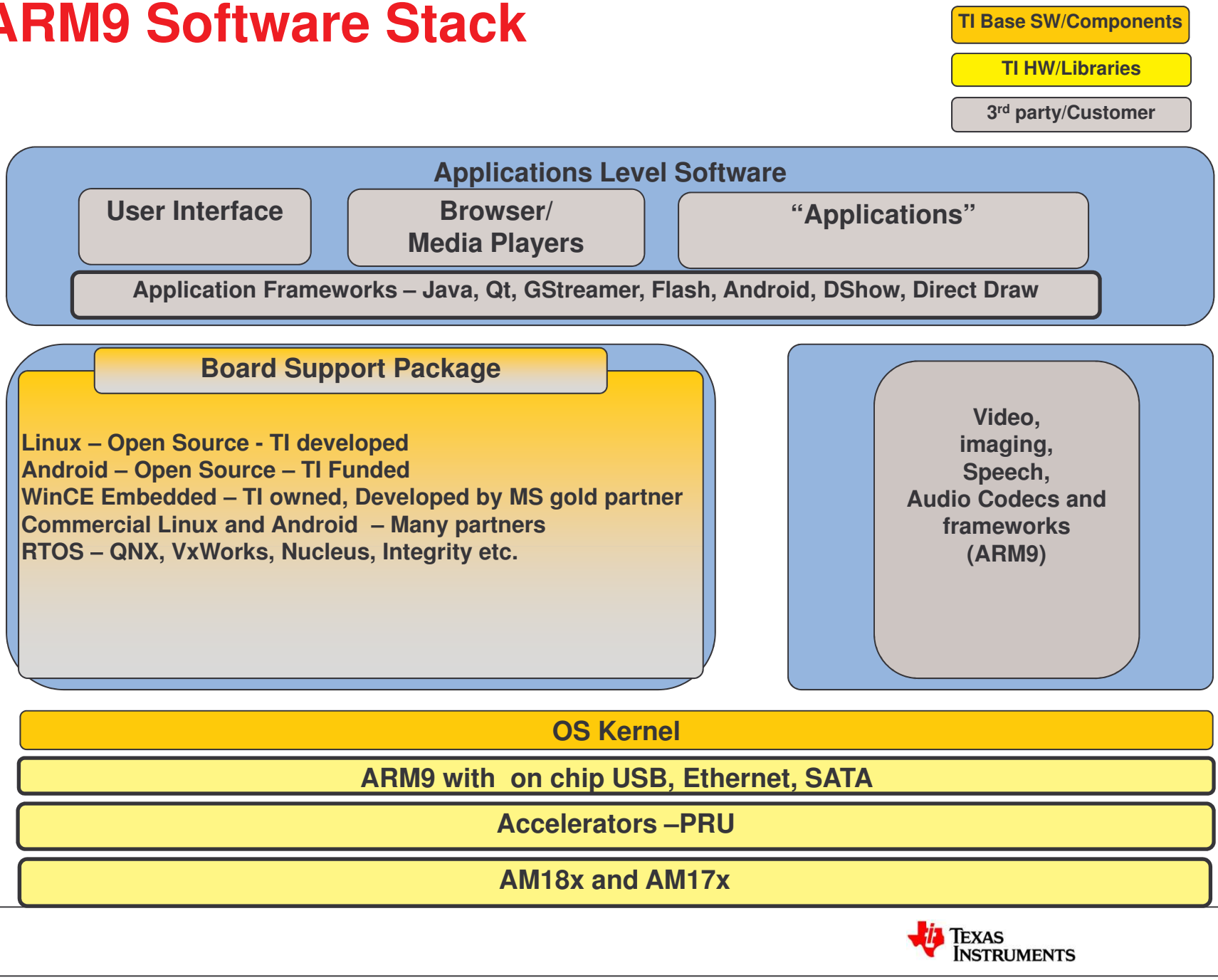
    - Linux kernel 2.6.33 BSP
    - Windows® Embedded CE BSP
  - Full peripheral driver library
  - Demos: PRU, touchscreen and more
  - PRU configurable tool
- **All this enables customers to rapidly develop and deploy their products at competitive R&D costs**

Active open source community and large ecosystem of developers:

RealView Tools by ARM® | CodeSourcery | Microsoft Windows CE | Linux Powered

ARM9 Software Stack



Commercial Linux Vendors

Vendor	Capabilities	Supported Platforms
TimeSys	Linux build tool with support for multiple kernel versions and middleware packages that enables users to easily customize distribution. Lower cost than MV and WRS	OMAP3530, DM355, OMAP-L137, DM6446, OMAP-L138, AM 3517
Montavista	MVL Pro 4 and 5 are distributions based on frozen version of Linux kernel. MVL 6 is based on 'GIT Linux' released by TI. Customized distributions (mobilinux, carrier grade) targeted at vertical segments.	OMAP3530, DM355, DM365, DM6446, DM6467, OMAP-L137, OMAP-L138, AM3517
WindRiver	Distributions based on frozen version of Linux kernel. 'Frozen' kernel is updated every two years to later release. Customized distributions targeted at vertical segments (mobile, networking)	OMAP3530, DM355, OMAP-L137, OMAP-L138, AM 3517

Linux SW Dev Tool: CODESourcery

Sourcery G++

- Complete software development environment based on the open-source Linux GNU Toolchain for ARM code development with broad adoption in the Linux community.
- Includes the GNU C and C++ compilers and run-time libraries, a source- and assembly-level debugger Debugger, the Eclipse IDE, and many more tools designed for ARM platforms and Linux application development.

Important Note

- Sourcery G++ will be included in EVM Kits by TI and
- Link will be provided to Code Sourcery web site from TI.com; Customers to choose Sourcery G++ SW Edition of choice.

Sourcery G++ Software Editions	Lite	Personal	Professional
30-day Installation Support	No	Yes	Yes
Unlimited Support	No	No	Yes
Priority Defect Correction	No	No	Yes
Access to Updates, Knowledge Base	No	Yes	Yes
Big Endian, Neon support	No	No	Yes
GNU/Linux Application Simulator	No	Yes	Yes
GNU C/C++ Compiler	Yes	Yes	Yes
GNU Debugger (GDB)	Yes	Yes	Yes
Eclipse IDE	No	Yes	Yes
Annual Subscription Price per Host	Free	$399	$2799

–Professional Edition: Designed for enterprise software development; including Extra run-time libraries

–Personal Edition: Designed for individuals and small development teams; including access to updates and knowledge base

–Lite Edition: Free, command line-only tools

More Linux Tool Support Options

Tool	Debug	Compile	Other Features and link
TI Code Composer Studio	Low Level DSP and ARM	Low-level ARM (ARMv7) and DSP (NEON roadmap)	Power Aware Debug
ARM Real View	Low Level ARM	Application-level ARM (ARMv7, NEON)	http://www.arm.com/products/DevTools/
Green Hills	Low Level and User level ARM debug and DSP	Low Level ARM	Trace http://www.ghs.com/products/arm_development.html
Lauterbach	Low Level and User level ARM debug and DSP	None	Extensive Trace support http://www.lauterbach.com/frames.html

3rd Party ARM Speech Codecs

Vendor	Speech Codecs	Audio Codecs
Ittiam	G.711 (E/D), G.726 (E/D), GSM-AMR NB (E/D)	AAC-LC(E/D), AAC-HE(E/D), MP3(E/D), BSAC(D), FLAC(D), OGG VORBIS (D), WMA(E/D), Dolby-AC3 5.1(E/D), WMA-Lossless (D),WMA-Pro LBR (D), MP2-5.1 (D),AAC-LC5.1 (E/D), WMA Pro 5.1 (E/D), Enhance AAC+ 5.1 (E/D) http://www.ittiam.com/pages/products/products.htm
Ingenient	G.726(E/D), GSM-AMR WB+ (E/D)	AAC-LC(E/D), AAC-HE(E/D), MP3(E/D), BSAC(D), FLAC(D), OGG VORBIS (D), WMA(E/D), Dolby-AC3(E/D) More Information: http://www.ingenient.com/multimedia_compression.html
CouthIT	G.711 (E/D), G.722.1 (E/D), G.723.1A (E/D), G.726 (E/D), G.728 (E/D), G.729 AM (E/D), GSM-AMR NB, WB and WB+ (E/D), EVRC (E/D), ILBC (E/D)	MP3 (D) http://www.couthit.com/codecs.asp

3rd parties ARM codec List

ARM Cortex A8 Video and Image Codecs

Vendor	Video Codecs	Image
Ittiam	DivX (D), H.263 Baseline (D), H.264 BP (E/D), H.264 MP (D), H.264 HP (D), MPEG4 ASP (D), MPEG4 BP (E/D), WMV9/VC1 BP/MP (D), MPEG2 (on request)	JPEG (E/D)
Visual ON	H.263 Baseline (D), H.264 BP (D), H.264 MP (D), MPEG4 SP/ASP (D), DivX,/xVID (D), WMV SP/MP(D),MPEG2 (D), SORENSON (D), ON2 (D), Real (D) Visual ON ALSO Support Audio/Speech decoders: AAC, AMR, WMA and MP3	JPEG(E/D) http://www.visualon.com/english/Products/VisualOnsoftwarecodecs.htm

Windows® Embedded CE SW Strategy

Customers can obtain CE 6.0

- Download BSP from TI

TI CE 6.0 BSP

- Drivers, Application Framework, & Graphics Package (Where ever applicable)
- Does NOT include any 3P ARM -based codecs

Development Tools: Visual Studio 2005 and Platform Builder

Support: Partners for BSP (some Hours FREE BSP support), Fee based Extended support.

For Graphics and Multimedia development - TI Forums & Community

Cost: BSP Download is Free*

Windows Embedded CE System Integrators / Consulting

Vendor	Expertise/Services
BSQUARE	TI Partner for BSP Development for OMAP35x. Supports system integration needs for customers. Specific solution are available for SD/MMC, Adobe Flash etc.
Logic PD	US based embedded hardware and SW design company. Familiar with TI devices. Working with many OMAP35x customers for WinCE system integration.
Adeneo	WinCE training, application and driver development. Based in France. Working with many OMAP35x for system integration around WinCE. Have very good experience with mass market WinCE support (training and enablement).
MPC Data	TI partner for WinCE BSP development for OMAP-L products. Have good knowledge about TI products.
Mistral	India-based embedded HW and SW design company. Familiar with TI devices, WinCE, and TI multimedia stack components. Developed WinCE 5.0 for TI on DM644x. Also developed WinCE 6.0 on DM644x and Support.

RTOS - Summary

- Available for purchase from commercial suppliers
- Sales and Support is provided by the RTOS Supplier
- TI works with RTOS supplier to enable their OS on TI platforms

Vendor	OS	Description	Link
QNX	**Neutrino**	Micro kernel based operating system. Support for different product segments.	http://www.qnx.com/products/neutrino_rtos/
Green Hills	**Integrity** **VelOSity**	Designed for reliability and security. Leader in security applications.	http://www.ghs.com/products.html
Wind River	**VxWorks**	Established RTOS vendor. Part of Intel now.	http://www.windriver.com/products/vxworks/
Mentor Gaphics	**Nucleus**	Nucleus is popular in wireless handsets. Extending the same to other markets also.	http://www.mentor.com/products/embedded_software/
Express Logic	**ThreadX**	RTOS targeted at deeply embedded applications	http://www.rtos.com/

Why Sitara™ ARM® microprocessors

- TI's Sitara family offer various combinations of high-performance and low power levels

- Customers can reduce system risks and accelerate time to market using standard and comprehensive HLOS Board support packages and ARM-based software development tools

- TI is the largest ARM core licensee supporting all major High Level Operating Systems

More Information

- AM35x landing page: www.ti.com/AM35x
- Sitara home page: www.ti.com/sitara
- ARM home page: www.ti.com/arm
- TI Embedded Processor Wiki: wiki.davincidsp.com
- Forums: e2e.ti.com
- Support: support@ti.com
- Open Source Software Portal: DesignSomething.org
- Training: www.ti.com/training

THANK YOU